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B.Sc. in EEE, 8th Semester

May 08, 2023
10:00 AM – 01:00 PM

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4803
Course Title: Engineering Materials

Winter Semester, A. Y. 2021-2022
Time: 3 Hours
Full Marks: 150

There are **6 (six)** questions. Answer all **6 (six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. a) Explain how dielectric loss of a dielectric medium can be quantified into a circuit. Formulate the equivalent series configuration. **12** (CO2, PO2, PO3)

   b) A parallel plate capacitor has an area of 350 mm^2 and the separation between plates is 0.2 mm. The space between the plates is filled with a dielectric having $\epsilon_r' = 2.85$ when subjected to the frequency of 0.5 MHz. The loss tangent at this frequency is 2.68×10^{-4}. Find the parameters of the equivalent circuit- **8** (CO2, PO2, PO3)
   (i) parallel R-C circuit and
   (ii) series R-C circuit.

   c) State the magnetic material that is used for less dielectric loss. Discuss the basic properties of that material. **5** (CO1, PO1, PO3)

2. a) Formulate the refractive index of a dielectric material as a function of frequency. Illustrate the graph between frequency and refractive index of a dielectric material having $\omega_0 = 2$. (Include both the real and imaginary parts in your illustration) **15** (CO1, CO2, PO3)

   b) Evaluate the statement- "the imaginary part of the refractive index is responsible for decay in propagating wave." **10** (CO1, PO1, PO3)

3. a) Explain with proper illustration how metal behaves as a transparent material in higher frequencies. (Using Drude Model) **12** (CO1, PO1, PO3)

   b) Suppose you are experimenting with a dielectric material with a negative refractive index. Illustrate how light will behave in that material. State at least two cases where this phenomenon can be applied. **13** (CO2, PO3)

4. a) Formulate the expressions that are pre-requisites for achieving surface plasmon polariton. Show the frequency required to achieve Surface plasmon resonance is $\omega = \frac{\omega_p}{\sqrt{2}}$. **20** (CO1, PO1)

   b) State a few areas where surface plasmon polariton (SPP) can be applied. **5** (CO2, PO3)

5. a) Describe the characteristic of different types of magnetic materials and compare between them. Explain which one is suitable for engineering application with proper examples. **15** (CO1, CO2, PO1, PO3)

   b) Compare the differences between hard and soft magnetic materials. Explain with proper graphs. **10** (CO1, PO1)

6. a) Explain how Schrödinger came up with a wave equation for the quantum particle. **8** (CO1, PO1)

   b) Solve the Schrödinger's wave equation with proper explanation. **17** (CO1, PO1)